



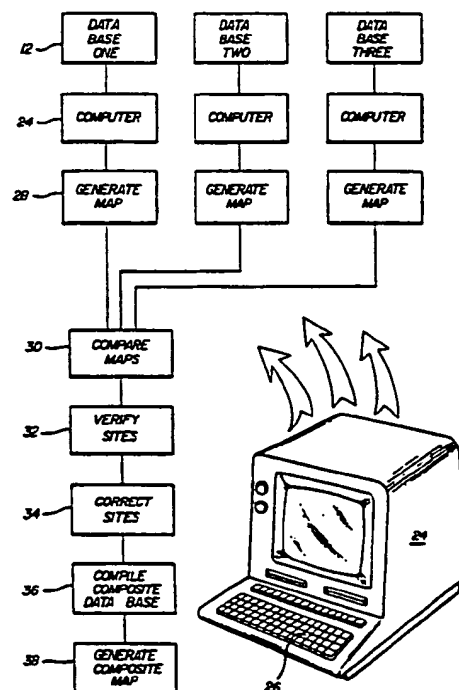
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(54) Title: METHOD FOR GENERATING MAPS

## (57) Abstract

A method for generating a composite map (38) of geographic locations from a plurality of data bases (12) is disclosed. Each data base (12) includes a set of geographic coordinate data using various geocoding systems. The method comprises the steps of inputting the coordinate data into a computer (24), generating a map corresponding to each data base (28) and comparing and correcting (30) each of the generated maps. The method further includes the steps of preparing a composite data base (36) of all the corrected data (34) and generating a composite map (38).



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## METHOD FOR GENERATING MAPS

### Background of the Invention

#### Field of the Invention

The present invention relates generally to  
5 cartography or map-making, and more particularly, to a  
method for generating a composite map from information  
contained in a plurality of data bases identifying a  
plurality of locations by various geographical coordinate  
data. Specifically, the invention provides a method for  
10 generating a composite map corresponding to existing and  
potential environmentally hazardous locations impacting  
a parcel of real estate.

#### Description of the Related Art

Environmental contamination of a real estate  
15 often results in the diminution of its economic value.  
Investigating the environmental integrity of the property  
is therefore crucial in the purchasing decision.  
Traditional methods of investigating the condition of  
real estate include questionnaires, title reports,  
20 surveys and appraisals. However, the inaccessibility of  
information relating to environmental contamination of  
property makes the investigation difficult.

Federal, state and local government agencies  
compile information regarding known and potential  
25 environmentally hazardous sites. Environmentally  
hazardous sites include real estate property subject to

environmental contamination, property located near earthquake faults or in floodplains, or any property having undesirable characteristics which affect the value of the property. The information is recorded in data 5 bases, such as the list of Federal Superfund Sites, the National Priority List of Superfund Sites, listings of state superfund sites, state landfill and disposal sites, state hydrocarbon production sites of environmental contamination as well as local or county listings of 10 environmentally hazardous sites. This information is regarded as "nominally public" because separate inquiries must be sent to each of the agencies responsible for placing a hazardous site in its respective database.

Furthermore, the information contained in 15 various data bases may be recorded under different geocoding systems, such as street address, metes and bounds description, or by a plat description. Oftentimes, the address corresponding to one site in one data base does not correlate with the address for the 20 same site in a different data base. These variations make it difficult to produce a single map containing information derived from a plurality of databases.

It can therefore be seen that there is a need for a method for generating a composite map from data 25 recorded in a plurality of data bases in different geocoding or geographical coordinate systems.

Summary of the Invention

The present invention provides a method for generating a composite map of geographic locations from a plurality of data bases. Each one of the plurality of 5 data bases identifies a set of geographic sites. Each site in each set is described by geographic coordinate data using various geocoding systems. The sites within a single set may also be recorded in different geocoding systems.

10           The claimed method comprises the steps of inputting the coordinate data of each set of geographic sites into a computer also provided with an application program for generating the map itself, and generating a plurality of maps, each map corresponding to one of the 15 plurality of data bases. Each generated map graphically shows the location of each geographic site within the corresponding data base.

          The method further includes the steps of comparing each of the generated maps with the others of 20 the generated maps for consistency of geographic characteristics of the location of each geographic site and correcting any inconsistent coordinate data. By consistency is meant accuracy in site location as well as uniformity between data bases in describing each site in 25 the same geocoding system.

          The method also includes the steps of compiling a composite data base including all the corrected geographic coordinate data for each set of geographic

sites within each of the plurality of data bases as well as inputting the composite data base into the computer and generating a composite map of all the locations corresponding to the sites contained in the composite  
5 data base.

The plurality of data bases used for generating the composite map may include any information for which a composite map is needed. For example, the present invention is directed to generating a composite map  
10 identifying environmentally hazardous geographic locations. Data bases such as the list of Federal Superfund Sites, the National Priority List of Superfund Sites, lists of state superfund sites, state landfill and disposal sites, state hydrocarbon production sites with  
15 environmental contamination as well as equivalent local or county listings are all possible data bases which can be used within the present method to generate a composite map correctly identifying all known environmentally hazardous locations.

20 The method claimed herein allows the user to generate a composite map of all the sites identified in a plurality of data bases. The composite map produced by the claimed method is both more accurate and more complete than those which could be produced by the prior  
25 art. These and other advantages of the present invention will be readily apparent from the drawings, discussion, description and claims which follow.

Brief Description of the Drawings

FIGURE 1 is a schematic flow diagram of the map generating method of the present invention;

FIGURE 2 is a computer generated map of a specific area having geographic sites subject to environmental contamination plotted from geographic coordinate data contained in the Federal Superfund data base;

FIGURE 3 is a computer generated map of geographic sites for the same area as Figure 2 plotted from geographic coordinate data from the Michigan Sites of Environmental Contamination data base;

FIGURE 4 is a computer generated map of geographic sites for the same area as Figures 2 and 3 plotted from geographic coordinate data contained in the Oakland County, Michigan, Listing of Environmental Contamination data base; and

FIGURE 5 is a composite computer generated map of the area of Figures 2-4 showing all the sites subject to environmental contamination generated by one embodiment of the method of the present invention.

Detailed Description of the Preferred Embodiment

Referring now to the drawing, Figure 1 is a schematic flow diagram of the map generating method of the present invention. The method generates a composite map of geographic locations from a plurality of data bases, generally indicated at 12, portions of which are

shown in tables 1, 2 and 3, respectively, below. Each of the data bases 12 identifies a set of geographic sites by geographic coordinate data using various geocoding systems. For example, the sites in each data base 12 may be recorded by a metes and bounds description, a street address, longitude and latitude description or by a plat description. The sites contained in each data base may correspond to any subject which is capable of being plotted on a two-dimensional map, such as the environmentally hazardous locations including locations near earthquake faults or floodplains, locations of real estate having undesirable characteristics, and in the illustrated embodiment, locations subject to environmental contamination. Other locations may also be plotted.

There is often difficulty, however, in plotting the geographic sites contained within each data base 12. Different geocoding systems may be used to describe the same parcel of real estate which may also be incorrectly recorded. For example, Table 1 lists the geographic locations subject to environmental contamination for one specific area of Troy, Michigan in the Federal Superfund data base.

Table 1: Federal Superfund Data Base

<u>25 Map Reference</u>	<u>Site Name</u>	<u>Location/Address</u>
14	Acme Dump	3000 Lake Ridge Rd.
16	Smith Tool & Die	12202 Harrison Rd.



Table 2 lists locations subject to environmental contamination for the exact same area in the corresponding state data base.

Table 2: State Sites of Environmental Contamination

<u>5 Map Reference</u>	<u>Site Name</u>	<u>Location/Address</u>
14	Acme Dump	1500 Lake Ridge Rd.
18	Jones Disposal Co.	SW 1/4 NE 1/4 Sec.20
20	John's Gas Station	12778 Apple Rd.

Table 3 lists the corresponding county listing of geographic locations subject to environmental contamination for the identical area.

Table 3: County Listing of Sites of Environmental Contamination

<u>Map Reference</u>	<u>Site Name</u>	<u>Location/Address</u>
15 14	Acme Dump	1500 Lake Ridge Rd.
22	Hillman Landfill	23333 Boyer Ridge Rd.

As can be seen from the geographic sites identified in each of the above tables, discrepancies exist between locations/addresses as well as the geocodings systems used to describe the sites. Also, the different data bases include different sites even though each data base is meant to include all sites subject to environmental contamination for the same specific area. For example, the state data base of sites of environmental contamination list three geographical sites whereas the federal and county data bases list two sites.

Only one of the sites is the same in all three data bases.

The first step in the present map generating method is to input the coordinate data of each of the 5 sets of sites within the plurality of data bases into a computer 24. This can be done by a computer keyboard 26 wherein an operator manually enters the coordinate data into the computer 24 or by magnetic tape wherein the computer is programmed to read the coordinate data 10 directly from the magnetic tape.

The computer 24 is programmed with a geographic information systems program capable of plotting a plurality of sites in a two-dimensional coordinate system. The geographic information systems program 15 includes commercially available software written in various computer languages. The software can be run on any level computer hardware from a personal computer to a main frame computer. An example of such software is produced by Environmental Systems Research Institute, 20 Inc., of California, under the registered trademark pc ARC/INFO®. The pc ARC/INFO® system is a vector-based geographic information system software program for storing, managing, analyzing, and displaying spacially oriented geographic data. Similar geographic information 25 systems software are commercially available. The computer is also provided with a database compatible with the geographic information systems program suitable for generating a map of the geographic area involved.

After all of the sets of geographic coordinate data from a data base 12 has been inputted into the microprocessor, the geographic information systems program generates a map of the locations corresponding to 5 each site within that data base. The present method also contemplates manually plotting the geographic sites. Figures 2, 3 and 4 are examples of maps generated by the geographic information systems software for the federal, state and county data bases described above. Map 10 references 14-22 described above have been plotted for an area of Troy, Michigan. Obviously, this area has been chosen as an example only, and is not meant as a limitation upon the present invention. The present invention can be utilized to plot coordinate data for 15 other areas as well. Figure 2 is a map of the sites recorded in Federal Superfund database. Figure 3 is a map of the state sites of contamination and Figure 4 is a map of the county listing of sites of environmental contamination.

20 As shown, the Acme Dump site 14 is plotted on all three database maps, 2, 3 and 4. However, there is a discrepancy between the site address as plotted on Figure 2 and that which is plotted on Figures 3 and 4. Figure 2 locates the site at 3000 Lake Ridge Road while 25 Figures 3 and 4 plot the location address at 1500 Lake Ridge Road. This a common example of inconsistent and inaccurate geographic coordinate data between one or more data bases. Site 16, Smith Tool and Die, is plotted on

Figure 2 but does not appear on Figures 3 and 4. This is a common example of omissions made by government agencies in reporting geographical site data in data bases.

Jones Disposal Company 18, plotted on Figure 3, reports an incorrect section number for the city within which it is located. Verification, as will be discussed in detail below, indicated that Jones Disposal Company 18 is actually located within Section 2, not Section 20 as reported in the state database. This is also an example of inconsistent geocoding within the same data base.

John's Gas Station 20 as shown in Figure 3, provides an address in the database not sufficient for plotting. The actual address for John's Gas Station is South Apple Road, not Apple Road as listed in the database, making plotting impossible. This is a common example of insufficient reporting of addresses.

The Hillman Land Fill 22 as shown in Figure 4 and listed in the county listing of environmental contamination sites is reported under a completely incorrect street address. Furthermore, the site is not shown in Figures 2 and 3, nor listed in the respective databases. All of the above errors make it impossible for the geographic information system software to accurately plot geographic coordinate data for sites which are reported in different data bases.

After the initial computer generated maps 2, 3 and 4 are made by the software, the next step is to compare each of the generated maps with the others of the

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generated maps for consistency in plotting the coordinate data. The comparison 30 may be done visually or by a mechanical comparator which compares significant points on one two-dimensional coordinate plot to significant 5 points on another. Also, the initial computer generated maps of Figures 2, 3 and 4 may be plotted on transparent plastic overlays so that one map may be placed directly over another to permit easy visual comparison of locations.

10           Verifying the geographic coordinate data in the plurality of data bases is the next step in the method of the present invention. Verification may be done by physically visiting the site or location or by telephoning the site to request a proper address.

15           After the verification has been completed, the next step is to correct 34 the inconsistent locations/addresses in the data bases. Correction 34 can be done manually and also includes identifying omissions between data bases 12 and rectifying them by supplying 20 proper geocoding to enable accurate plotting of the sites into the geographic information system.

          The next step in the method is to compile 36 a composite data base including all of the corrected and verified geographic coordinate data for each set of 25 geographic sites from each data base 12. This can be done by inputting the composite information into the computer 24 through the use of the computer keyboard 26 or through magnetic tape as described above. Table 4

lists the composite data base compiled using the above referenced Federal, state and county data bases 12 for the illustrated example, including the correct geographic coordinate data.

5                    Table 4: Composite Data Base of  
                     Sites of Environmental Contamination

<u>Map Reference</u>	<u>Site Name</u>	<u>Location/Address</u>
14	Acme Dump	1500 Lake Ridge Rd.
16	Smith Tool & Die	12202 Harrison Rd.
10    18	Jones Disposal Co.	SW 1/4 NE 1/4 SEC
2		
20	John's Gas Station	12778 S. Apple Rd.
22	Hillman Land Fill	2333 Boyer Ridge Rd.

15 The geographic information system software resident in computer 24 then generates a composite map as shown in Figure 5 containing the corrected locations subject to environmental contamination for that particular parcel of real estate.

20                    In light of the foregoing, it should be apparent that many variations are possible within the scope of the present invention. Accordingly, the foregoing drawings, discussion and description are merely meant to be illustrative of particular embodiments of the  
25 invention and not limitations upon the practice thereof. It is the following claims, including all equivalents, which define the scope of the invention.

Claims

1. A method for generating a composite map of geographic locations from a plurality of data bases, each of said plurality of data bases including a set of 5 geographic sites recorded therein by means of geographic coordinate data using various geocoding systems, said method comprising the steps of:

inputting the coordinate data of each set of geographic sites into a computer having an application 10 program for generation of maps;

generating a map of geographic locations each having geographical characteristics from the coordinate data of each of said sets of geographic sites, said generated map corresponding to one of the plurality of 15 data bases;

comparing each of said generated maps with the others of said generated maps for consistency of geographic characteristics of the geographical locations thereon;

20 correcting any inconsistent geographic characteristics;

compiling a composite data base of geographic sites including geographic coordinate data corresponding to the correct geographical characteristics for each 25 geographic site; and

inputting said geographic coordinate data from said composite data base into said computer to generate

a composite map including geographic locations corresponding to the correct coordinate data for each geographic site.

2. The method as in claim 1, further including  
5 the steps of verifying the geographic coordinate data of each of said sets of sites.

3. A method for generating a composite map identifying environmentally hazardous geographic locations, said method comprising the steps of:

10 inputting into a computer having a program for generation of maps, geographic coordinate data from a plurality of data bases, each of said plurality of data bases identifying a set of geographic sites by various geocoding systems;

15 generating a map corresponding to each of said plurality of data bases and having geographic locations having geographic characteristics thereon corresponding to each of said sites identified by the various geocoding systems;

20 comparing each of said generated maps with the others of said generated maps for consistency of geographic characteristics of the geographic locations thereon;

correcting any inconsistent geographic  
25 characteristics;



15

compiling a composite data base including correct geographic coordinate data corresponding to the correct geographical characteristics for each geographic site; and

5           inputting said composite data base into said computer to generate a composite map including geographic locations corresponding to the correct coordinate data for each geographic site.

4. The method as in claim 3, further including  
10 the step of verifying the geographic coordinate data of each of said sets of sites.

## AMENDED CLAIMS

[received by the International Bureau on 13 October 1990 (13.10.90);  
original claims 1-3 amended; new claims 5 and 6 added;  
other claims unchanged (5 pages)]

1. A method for generating a composite map of geographic locations from a plurality of data bases, each of said plurality of data bases including a set of geographic characteristics recorded therein by means of geographic coordinate data using various geocoding systems, said method comprising the steps of:

inputting the coordinate data from each data based into a computer having an application program for generation of maps;

generating a plurality of maps each based on information contained in a corresponding one of said data bases;

comparing each of said generated maps with the others of said generated maps for consistency of geographic characteristics of the geographical locations thereon;

identifying any inconsistency of geographic characteristics of the geographical locations between said maps from said comparing step;

correcting any inconsistent geographic characteristics;

compiling a composite data base of geographic sites including geographic coordinate data corresponding to the corrected geographical characteristics for each geographic site; and

inputting said geographic coordinate data from said composite data base into said computer to generate a composite map including geographic locations corresponding to the corrected coordinate data for each geographic site.

2. The method as in claim 1, further including the step of verifying the geographic coordinate data of each of said sets of sites.

3. A method for generating a composite map identifying environmentally hazardous geographic locations, said method comprising the steps of:

inputting into a computer having a program for generation of maps, geographic coordinate data from a plurality of data bases, each of said plurality of data bases identifying a set of geographic characteristics by various geocoding systems;

generating a plurality of maps, each of said maps based on information contained in a corresponding one of said data bases;

comparing each of said generated maps with the others of said generated maps for consistency of geographic characteristics of the geographic locations thereon;

identifying any inconsistency of geographic characteristics of the geographical location between said maps from said comparing step;

correcting an inconsistent geographic characteristics;

compiling a composite data base including geographic coordinate data corresponding to the corrected geographical characteristics for each geographic site; and

inputting said composite data base into said computer to generate a composite map including geographic

locations corresponding to the correct coordinate data for each geographic site.

5. A method of generating a composite map of geographic locations from a plurality of data bases, each of said data bases including a set of geographic characteristics recorded therein by means of geographic coordinate data using various geocoding systems, said method comprising the steps of:

inputting the coordinate data from each data base into a computer having an application program for generating maps;

generating at least one map, said at least one map based on information contained in said plurality of data bases;

comparing the information of each of said data bases on said at least one map for consistency of geographic characteristics of the geographic locations thereon;

identifying any inconsistency of geographic characteristics of the geographical locations between said plurality of data bases on said at least one map;

correcting inconsistent geographic characteristics;

compiling a composite data base of geographic sites including geographic coordinate data corresponding to the corrected geographical characteristics for each geographic site; and

inputting said geographic coordinate data from said composite data base into said computer to generate a

composite map including geographic locations corresponding to the corrected coordinate data for each geographic site.

6. A method for generating a composite map identifying environmentally hazardous geographic locations, said method comprising the steps of:

inputting into a computer having a program for generation of maps, geographic coordinate data from a plurality of data bases, each of said plurality of data bases identifying a set of geographic characteristics by various geocoding systems;

generating a map from said plurality of data bases and having geographic locations having geographic characteristics thereon corresponding to each of said sites identified by the plurality of data bases with various geocoding systems;

comparing the information from the plurality of data bases of said map for consistency of geographic characteristics of the geographic locations thereon;

identifying any inconsistency of geographic characteristics of the geographical location on said map from said comparing step;

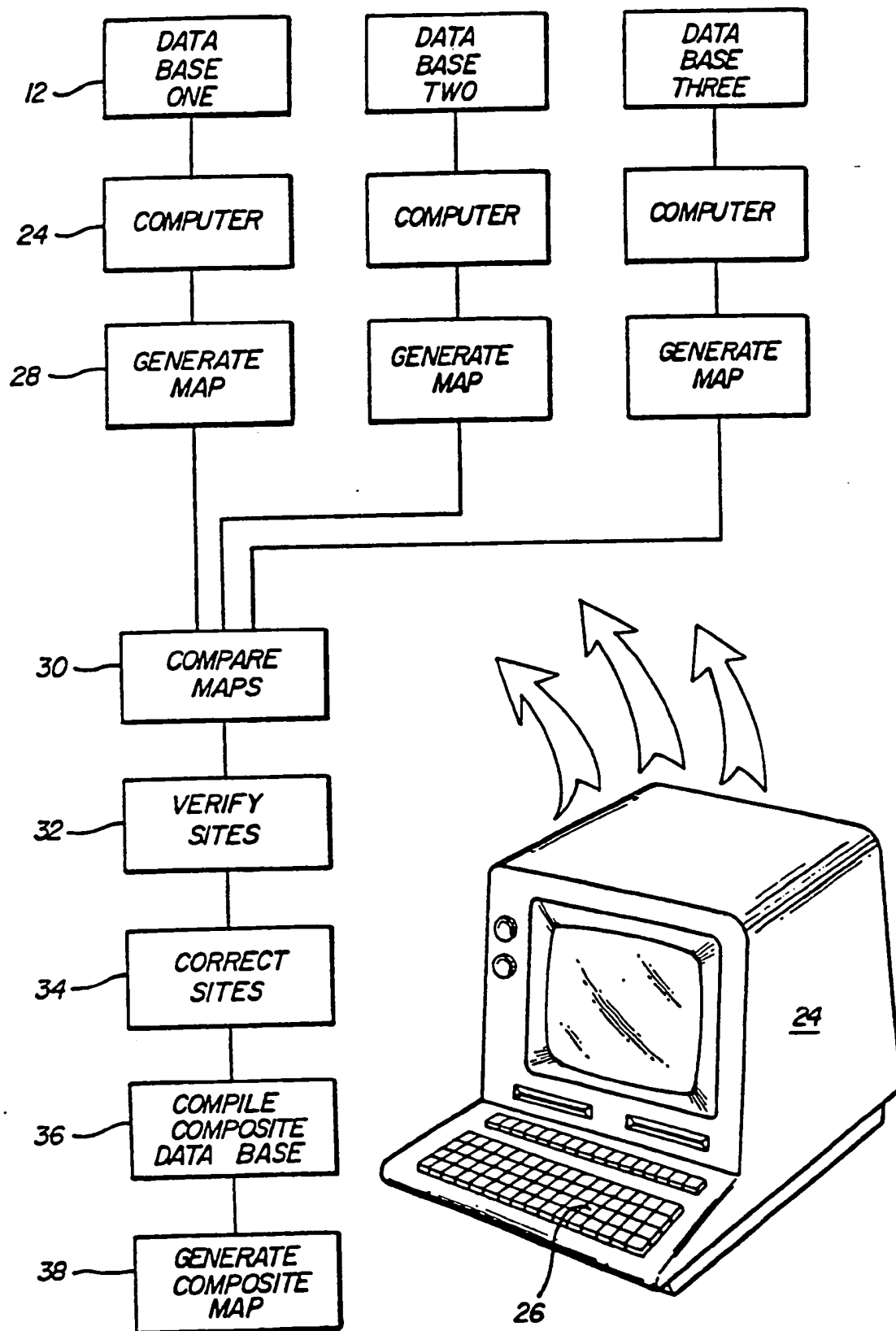
correcting any inconsistent geographic characteristics;

compiling a composite data base including correct geographic coordinate data corresponding to the corrected geographical characteristics for each geographic site; and

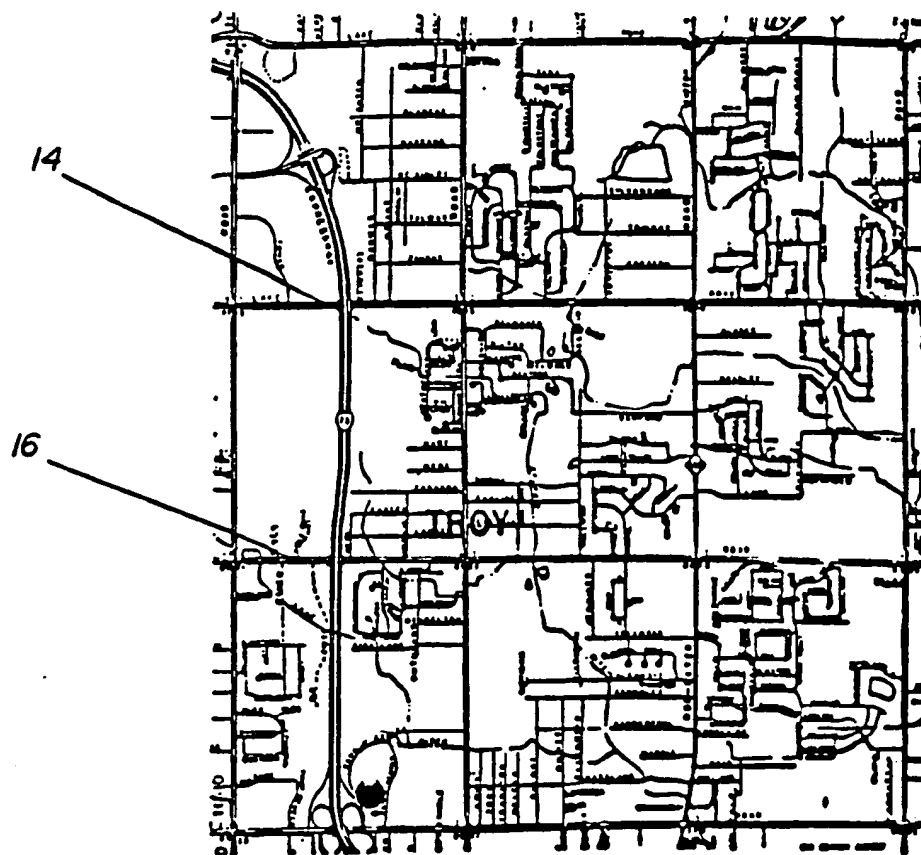
inputting said composite data base into said computer to generate a composite map including geographic

locations corresponding to the correct coordinate data for  
each geographic site.

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FIG. 1

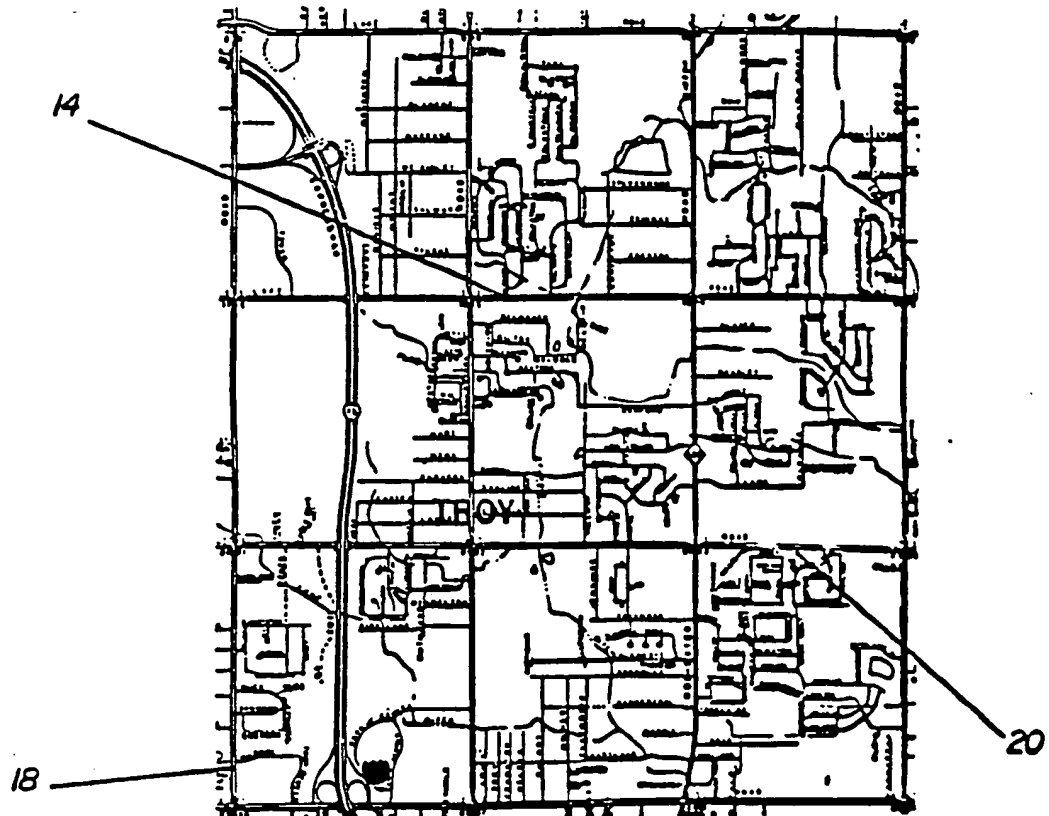
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FIG. 2

FEDERAL SUPERFUND DATA BASE  
( INITIAL COMPUTER GENERATED MAP )



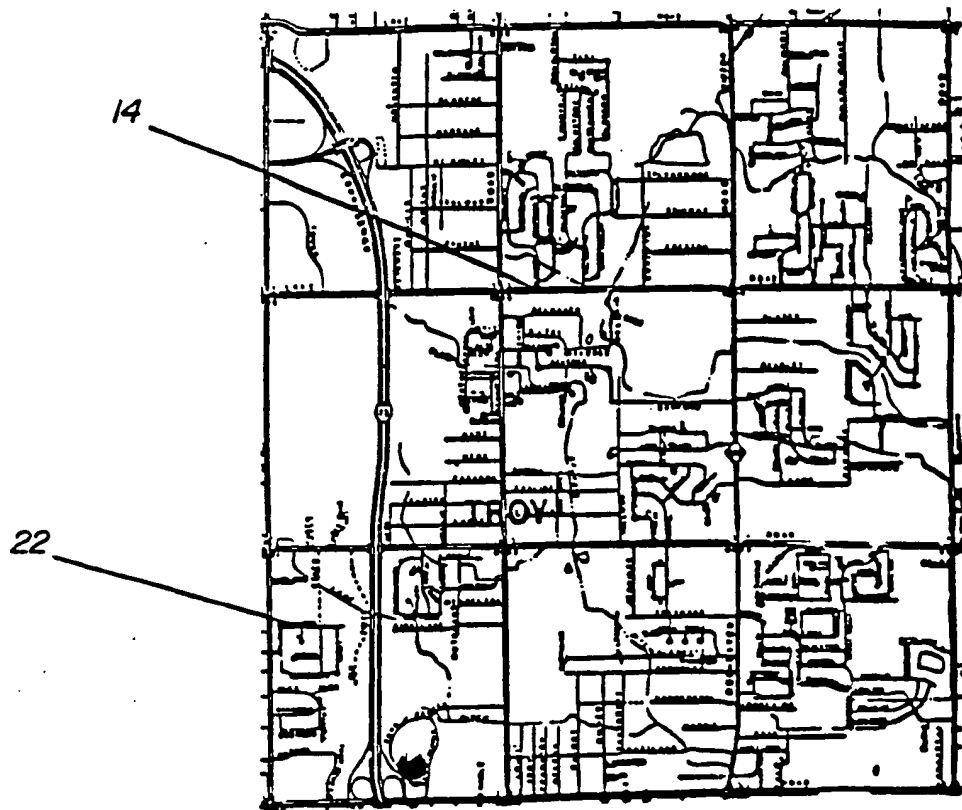
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FIG. 3

STATE SITES OF ENVIRONMENTAL CONTAMINATION  
( INITIAL COMPUTER GENERATED MAP )

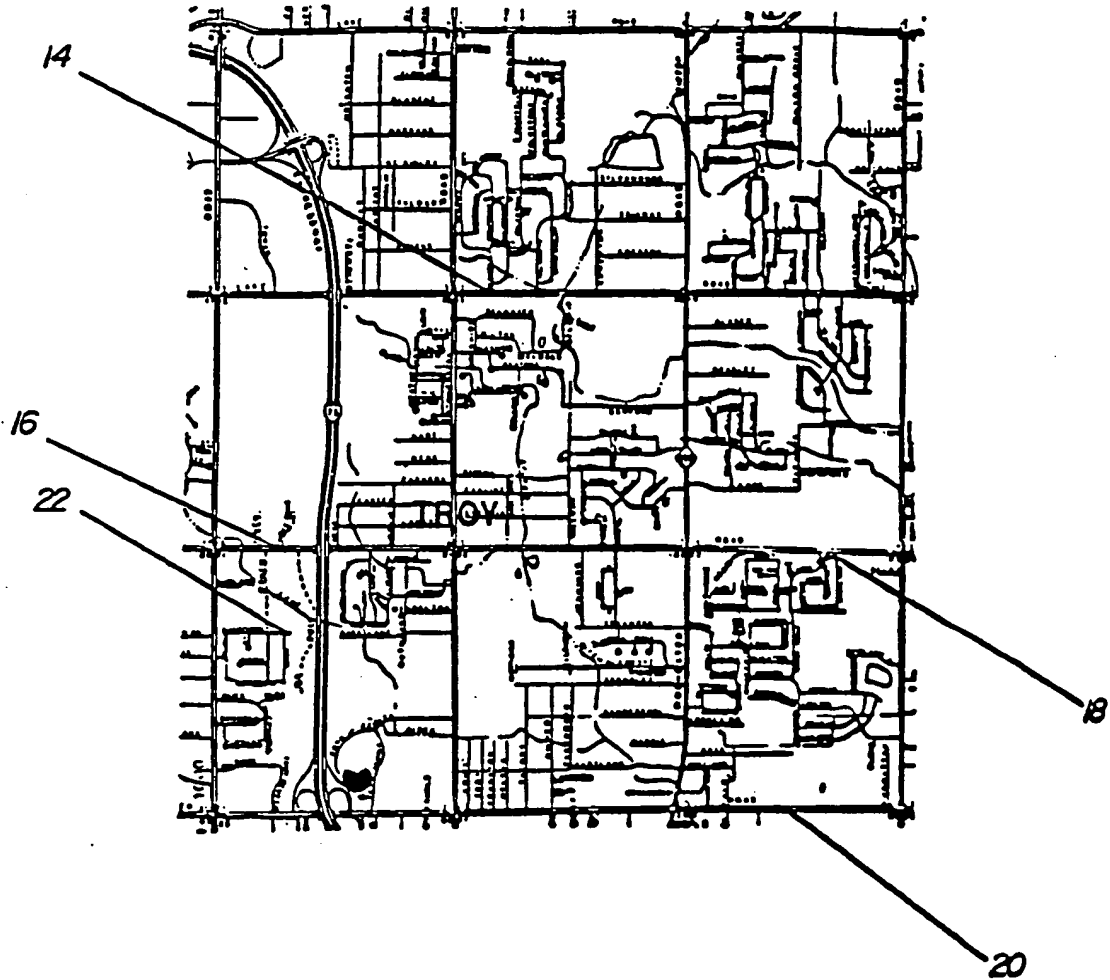
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FIG. 4

COUNTY LISTING OF SITES OF ENVIRONMENTAL CONTAM-  
INATION (INITIAL COMPUTER GENERATED MAP)

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FIG. 5

FINAL COMPOSITE COMPUTER GENERATED MAP

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/US90/02880

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (If several classification symbols apply, indicate all) <sup>3</sup> According to International Patent Classification (IPC) or to both National Classification and IPC IPC(5): G06F 3/00; G06K 9/36 US CL.: 340/723; 364/518		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched <sup>4</sup>		
Classification System	Classification Symbols	
US	364/518, 452, 571.08, 449, 447; 340/723, 745, 730; 382/56	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>5</sup>		
Automated Patent Search (APS): L1: S Map(P) Compsite; L2: S Data Base; L3: S L1 ans L2		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT</b> <sup>14</sup>		
Category <sup>6</sup>	Citation of Document, <sup>15</sup> with indication, where appropriate, of the relevant passages <sup>17</sup>	Relevant to Claim No. <sup>18</sup>
Y,P	US, A, 4,843,569 (SAADA ET AL.) 27 June 1989 See the entire document	1-4
Y,P	US, A, 4,873,513 (SOULTS ET AL.) 10 October 1989 See the entire document	1-4
Y,P	US, A, 4,891,761 (GRAY ET AL.) 02 January 1990 See col. 2, lines 26-68, col. 10, lines 4-33	1-4
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p><sup>9</sup> Special categories of cited documents: <sup>13</sup></p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"Δ" document member of the same patent family</p> </div> </div>		
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Date of the Actual Completion of the International Search <sup>2</sup>		Date of Mailing of this International Search Report <sup>1</sup>
17 SEPTEMBER 1990		12 OCT 1990
International Searching Authority <sup>1</sup>		Signature of Authorized Officer <sup>20</sup>
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